

WHAT IS CLAIMED IS:

1. A polynucleotide which is (a) a polynucleotide having a nucleotide sequence of SEQ ID NO:1; (b) a polynucleotide having a nucleotide sequence of SEQ ID NO: 4; or (c) a polynucleotide fragment of (a) or (b) encoding a functional domain of a cellulose synthase.
2. The polynucleotide of claim 1 wherein the polynucleotide is operably linked to a polynucleotide of SEQ ID NO: 3, or a functional fragment thereof.
3. A vector comprising a polynucleotide of claim 1.
4. A transgenic plant comprising a polynucleotide of claim 1.
5. A cellulose synthase promoter, or a functional fragment thereof which binds a transcription factor in a plant cell.
6. A vector comprising a promoter or a fragment of claim 5.
7. A transgenic plant comprising a promoter or a fragment of claim 5.
8. A polypeptide having an amino acid sequence of SEQ ID NO: 2, an amino acid sequence of SEQ ID NO: 5 or an amino acid sequence sequence which a functional domain of cellulose synthase.
9. A method of altering the growth of a plant, comprising expressing in cells of the plant an exogenous polynucleotide encoding a cellulose synthase wherein the polynucleotide is expressed in an amount effective to alter the growth of the plant.
10. A method according to claim 9, wherein the polynucleotide comprises a homologous polynucleotide.
11. A method according to claim 9, wherein the polynucleotide comprises a heterologous polynucleotide.
12. A method according to claim 9, wherein the polynucleotide is in a sense orientation.

13. A method according to claim 9, wherein the polynucleotide is in an antisense orientation.
14. A method according to claim 9, wherein a plant promoter, or a transcription factor binding domain thereof, is operatively linked to the polynucleotide.
15. A method according to claim 14, wherein the promoter is selected from constitutive promoters, tissue-specific promoters and developmental-specific plant promoters.
16. A method according to claim 15, wherein the promoter is Cauliflower Mosaic Virus 35S, 4CL, cellulose synthase promoter, *PtCelAP* or terminal flower promoter.
17. A polynucleotide encoding a UDP-glucose binding domain of a cellulose synthase.
18. A polypeptide comprising a UDP-glucose catalytic subunit of cellulose synthase wherein the UDP-glucose catalytic subunit catalyzes the biosynthesis of cellulose.
19. A method of altering the growth of a plant, comprising incorporating into a plant genome a polynucleotide encoding a UDP-glucose catalytic subunit wherein expression of the polynucleotide alters the growth of the plant.
20. A method according to claim 19, wherein the polynucleotide comprises a homologous polynucleotide.
21. A method according to claim 19, wherein the polynucleotide comprises a heterologous polynucleotide.
22. A method according to claim 19, wherein the polynucleotide is in a sense orientation.
23. A method according to claim 19, wherein the polynucleotide is in a antisense orientation.

24. A method of altering the cellulose content in a plant comprising expressing an exogenous polynucleotide encoding a UDP-glucose binding domain in a plant genome to alter the cellulose content of the plant.
- 5 25. A transgenic plant having an increased ratio of cellulose to lignin in cells of the plant comprising an exogenous polynucleotide encoding a cellulose synthase operably linked to a promoter so that the polynucleotide is expressed in an amount effective to increase the cellulose content of the plant.
- 10 26. A transgenic plant having a decreased ratio of lignin to cellulose, the plant comprising an exogenous polynucleotide encoding a cellulose synthase.
27. A method of altering expression of a cellulose synthase in a plant cell comprising delivering into the cell a vector comprising a polynucleotide encoding a cellulose synthase.
- 15 28. The method according to claim 27, wherein the polynucleotide comprises a homologous polynucleotide.
- 20 29. The method according to claim 27, wherein the polynucleotide comprises a heterologous polynucleotide.
30. The method according to claim 27, wherein the polynucleotide is in a sense orientation.
- 25 31. The method according to claim 27, wherein the polynucleotide is in an antisense orientation.
32. A method of causing stress-induced gene expression in a plant cell comprising delivering into the cell a vector comprising a cellulose synthase promoter operatively linked to a gene, wherein the gene is expressed upon a mechanical stress to the plant.
- 30 33. A method of determining a positive mechanical stress responsive element (MSRE) in a cellulose synthase promoter comprising:
- 35 (i) introducing into a plant a cellulose synthase promoter that has a portion deleted, the cellulose synthase promoter operatively linked to a polynucleotide encoding a reporter, and

(ii) detecting a decrease in the amount of reporter in the plant after inducing a stress to the plant.

34. A method of determining a negative MSRE in a cellulose synthase promoter comprising:

(i) introducing into a plant a cellulose synthase promoter that has a portion deleted, the cellulose synthase promoter operatively linked to a reporter gene, and

(ii) detecting an increase in the amount of reporter in the plant after inducing a stress to the plant.

35. A method of expressing cellulose synthase in a plant in a tissue-specific manner comprising transforming the plant with a tissue-specific promoter operatively linked to a polynucleotide encoding a cellulose synthase.

36. A method of increasing expression of a cellulose synthase in a plant comprising delivering into the plant a cDNA encoding a protein that binds to a positive MSRE of a cellulose synthase promoter wherein the binding to the positive MSRE results in expression of a cellulose synthase, resulting in increased expression of cellulose in the plant.

37. A method of reducing expression of a cellulose synthase in a plant comprising delivering into the plant a cDNA in an antisense orientation, the cDNA in a sense orientation encoding protein that binds to a positive MSRE and results in expression of a cellulose synthase.

38. A method of increasing cellulose biosynthesis in a plant comprising delivering into the plant a cDNA encoding a protein that binds to a positive MSRE of a cellulose synthase promoter, wherein binding of the protein to the positive MSRE results in expression of a cellulose synthase.

39. A method of reducing cellulose biosynthesis in a plant comprising delivering into the plant a cDNA in an antisense orientation, the cDNA in a sense orientation encoding protein that binds to a positive MSRE of a cellulose synthase promoter.

40. A transgenic plant containing a polynucleotide comprising a promoter and encoding a cellulose synthase, the polynucleotide expressed such that the growth of the plant is altered relative to a similar control plant that does not contain the polynucleotide.
- 5 41. A vector comprising a promoter functional in a plant cell, and a coding sequence for cellulose synthase, the coding sequence operably linked to the promoter, the promoter having a nucleotide sequence encoding a positive MSRE of cellulose synthase.
- 10 42. A method of altering a characteristic of a plant comprising genetically upregulating cellulose synthase in the plant, wherein the characteristic is accelerated growth, increased cellulose content or decreased lignin content.
- 15 43. The method of claim 42 wherein the plant is genetically upregulated through incorporation into the genome of the plant a cDNA having a nucleotide sequence encoding a cellulose synthase.
- 20 44. A method of regulating cellulose synthase expression in a plant comprising delivery in a plant (a) a cDNA encoding a polypeptide which is a positive MSRE of a cellulose synthase promoter; or (b) a cDNA in an anti sense orientation of the cDNA of (a), in amount and under conditions effective to allow at least a portion of the plant's cells to take up the cDNA.
- 25 45. A method of altering cellulose content in a plant comprising:  
(a) delivery into cells of the plant an expression cassette comprising a cDNA encoding a cellulose synthase operably linked to a promoter functional in a plant cell; and  
(b) expressing the cDNA in the cells of the plant in an amount effective to alter the cellulose content in the cells of the plant.
- 30 46. A DNA encoding a protein having cellulose synthase activity and comprising the amino acid sequence in SEQ ID NO:2, SEQ ID NO:5 or an amino acid sequence which is a functional domain of cellulose synthase.